TISA Products/Validation/Status

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9th CERES-II Science Team Meeting
City Center at Oyster Point, Newport News, VA, May 6-8, 2006

Outline

- SRBAVG-daily product status
- ISCCP-D2like products status, M Sun
- GSFC GEOS5 vs GEOS4 differences
- Adjusted CERES SRBAVG dataset, N. Loeb
- SYN/AVG/ZAVG status and validation
- GGEO (MTSAT calibration) status
- TISA Edition3 Improvements
- Edition number madness explained
- Products and schedules

- TISA objective is to time and space average all parameters thrown our way
  - Use linear interpolation as a default
  - Use SW directional models to estimate daily flux
  - Incorporate GEO retrieved cloud and fluxes to estimate diurnal signal

SRBAVG Daily

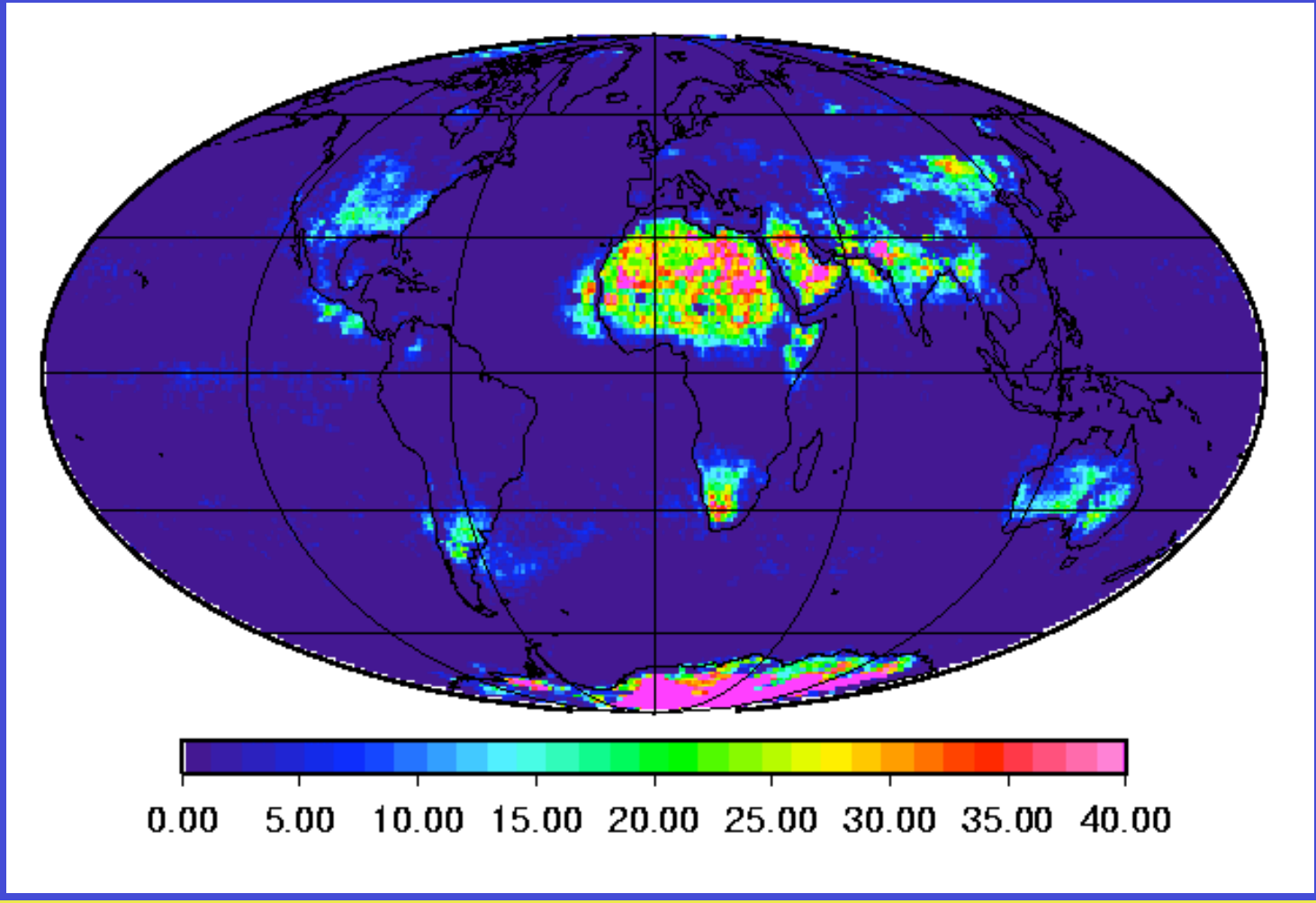
SRBAVG-Daily on Ed2E

- Provide daily fluxes and cloud properties
  - SRBAVG-daily**1** is the GEO (GEO & CERES) TOA, surface fluxes and clouds
  - SRBAVG-daily**2** is the nonGEO (CERES-only) TOA fluxes and MODIS clouds
- SRBAVG-daily2: also includes the MODIS product aerosols
  - 0.65μm and 1.6μm (Ignatov aerosols) in SRBAVG1 product
  - Monthly zonal incoming solar flux
  - Daily Snow/Ice coverage maps (snow+ice+IGBP permanent)
- Include Model B Terra based TOA clear-sky albedo map
- Corrects the RAPS mode GGEO/CERES SW normalization error
- SRBAVG product delayed in order to expedite SYN/AVG/ZAVG product

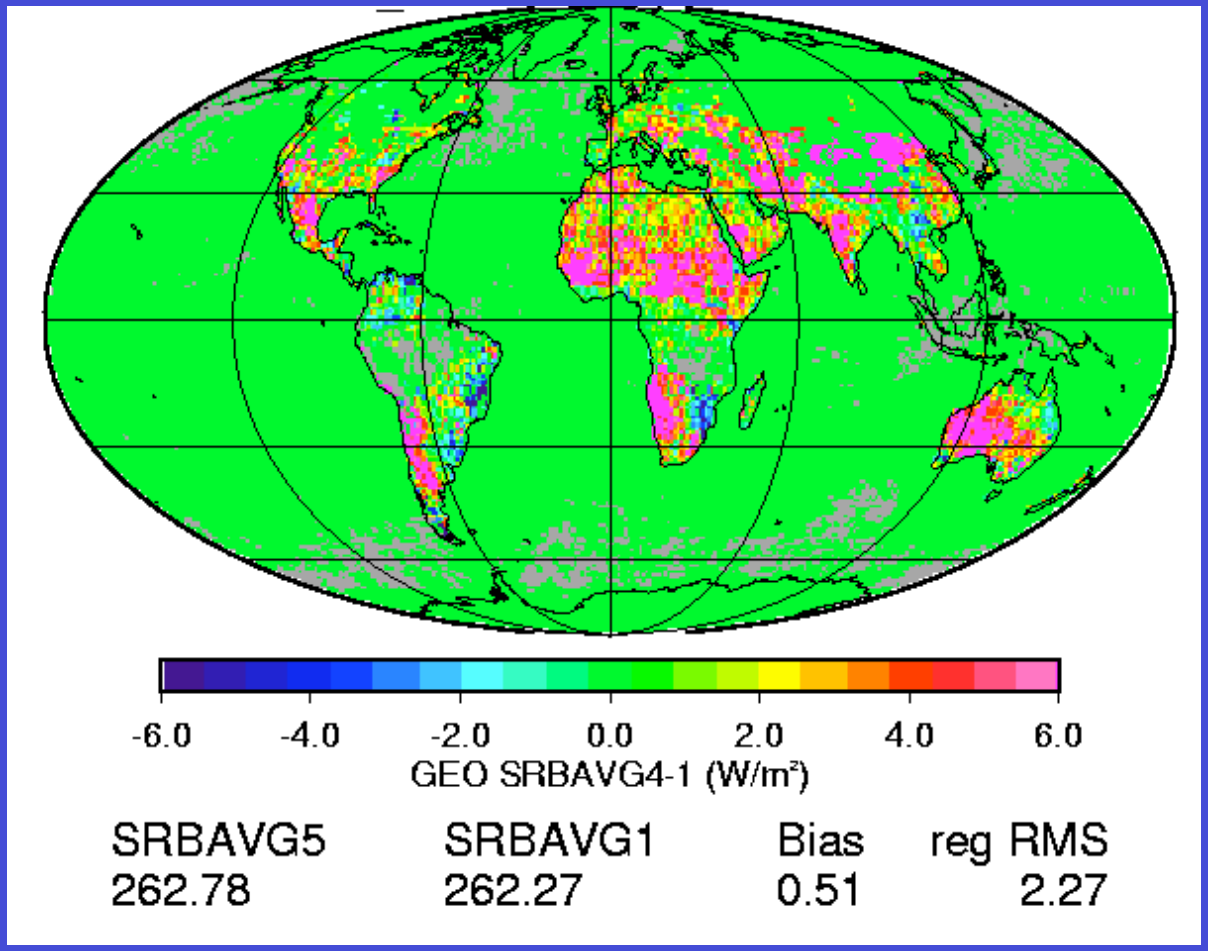
SRBAVG-daily temporal averaging validation

- Make sure all the daily parameters average to the monthly mean
  - To test, compute monthly mean flux from daily means from stand alone IDL HDF read code
  - Compare to monthly mean on SRBAVG files
- Overall consistency between daily and monthly
  - LW and cloud properties are linearly averaged
  - Daily twilight correction is applied to TOA SW daily fluxes
  - Surface Model A and B SW flux parameterization fail with SZA >80°
    - Estimate failed SW surface fluxes by interpolating transmission for SW down and surface albedo for SW up
  - Weight by daily flux SW flux to derive monthly mean flux
- Outstanding Issues
  - nonGEO clear-sky TOA LW, which is based on half-sine fit on monthly hourly fluxes, due to lack of clear-sky observations
  - Daily clear-sky TOA LW will be computed from daily half-sine fit
    - the average of the daily means will not equal the monthly mean

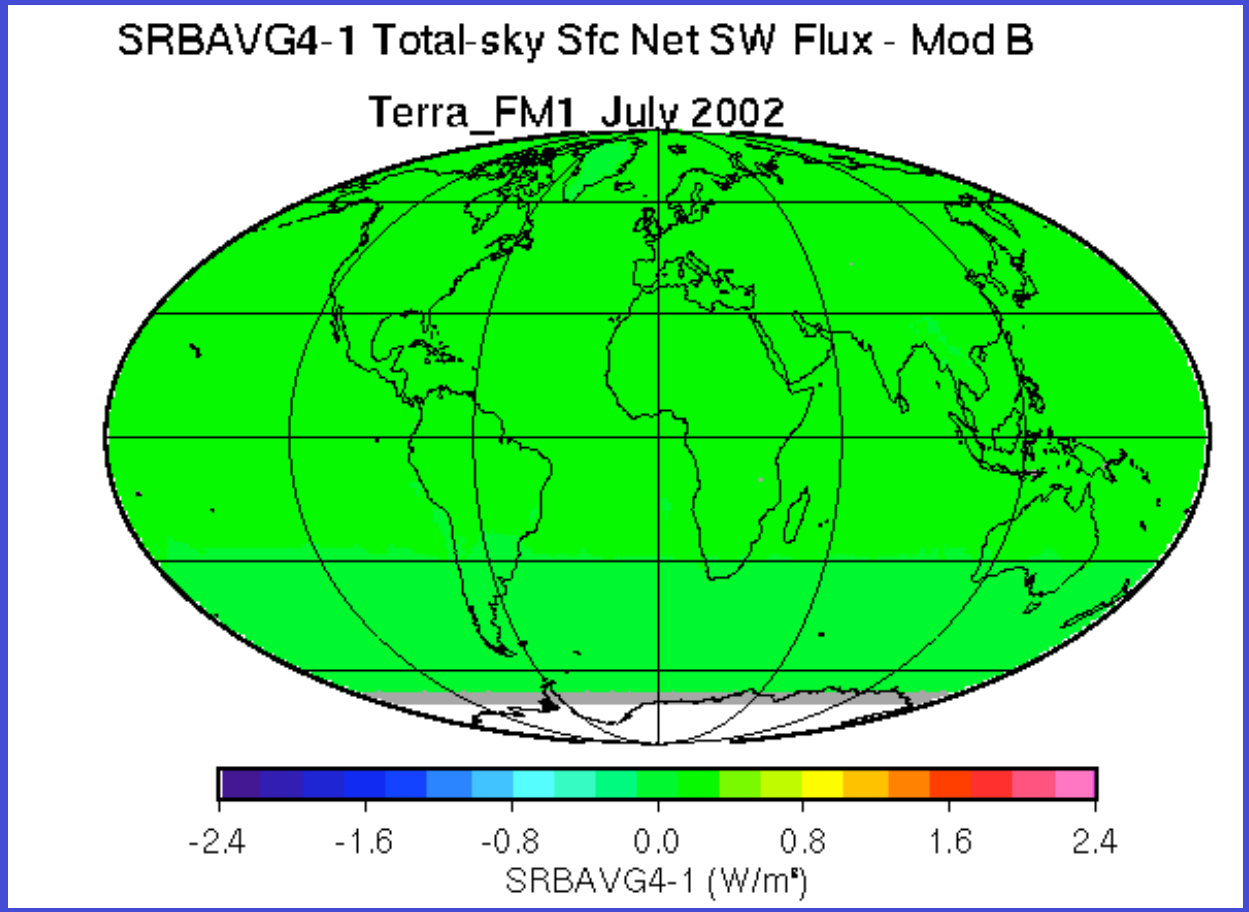
of nonGEO clear-sky LW measurements during Jan 2001



Averaged daily - monthly mean clear-sky LW flux Jan 2001

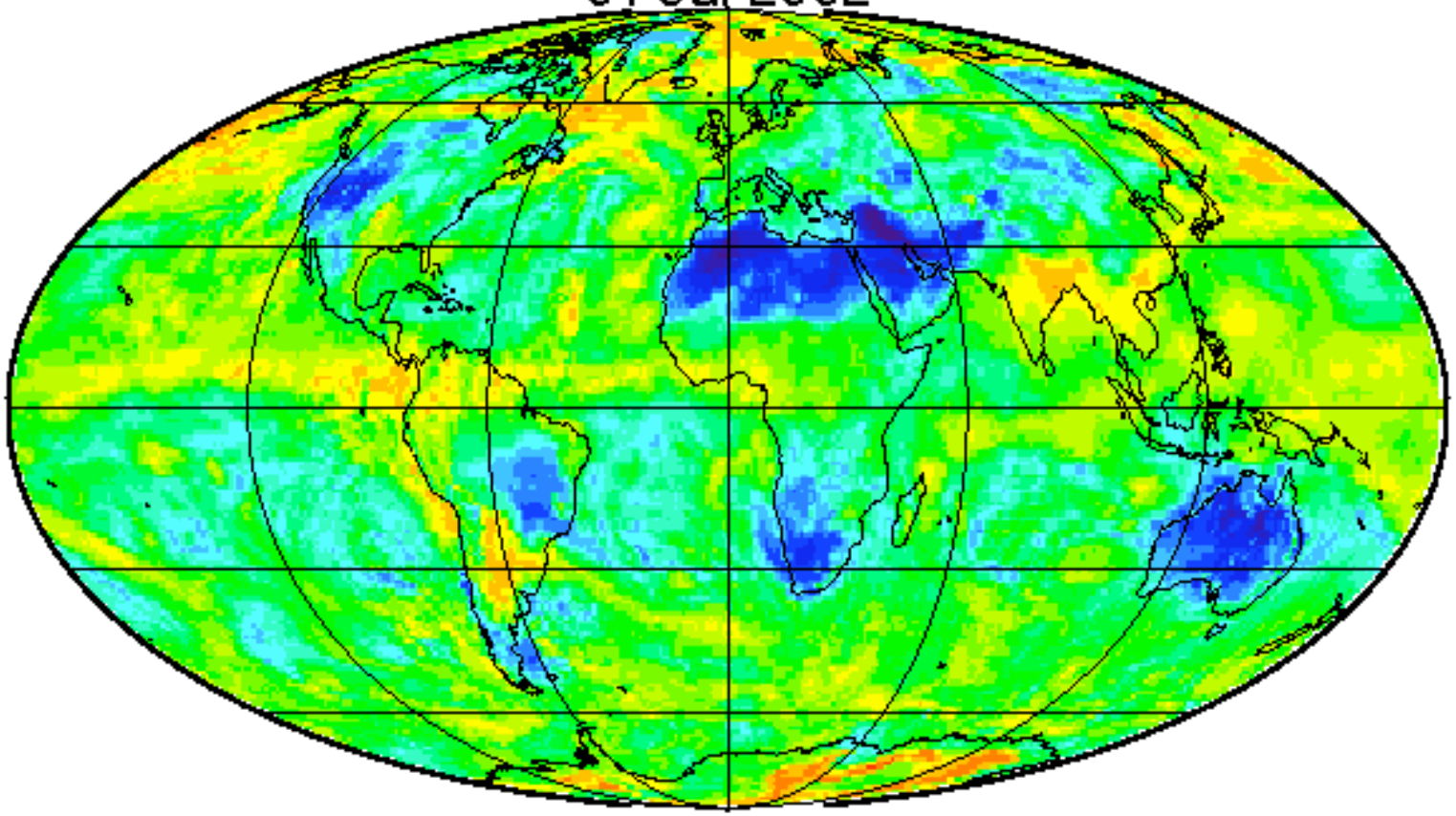


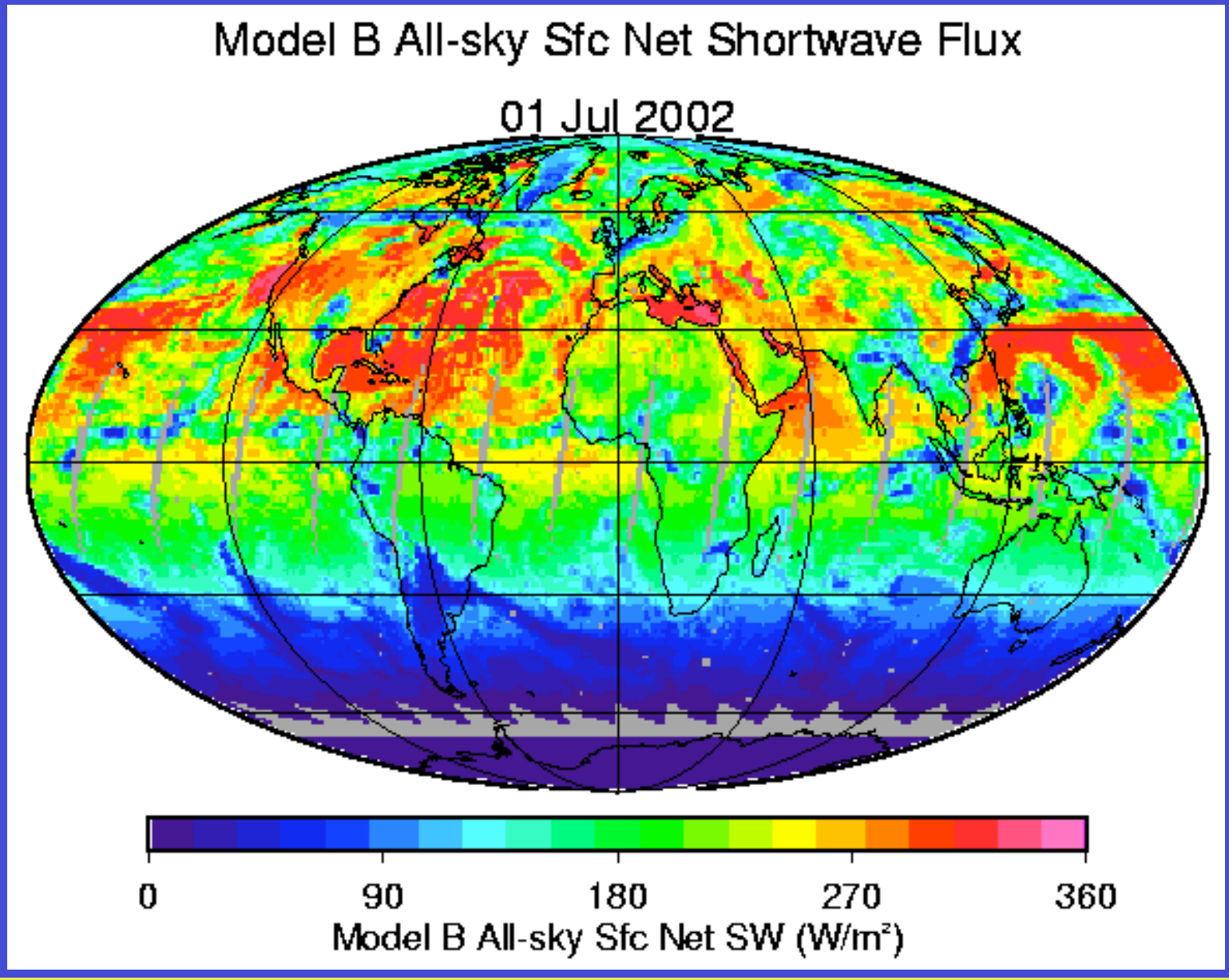
Total-sky SFC Net SW flux
daily derived - SRBAVG monthly means



Model B All-sky Sfc Net Longwave Flux

01 Jul 2002




Model B All-sky Sfc Net Shortwave Flux
01 Jul 2002
0
90
180
270
360
Model B All-sky Sfc Net SW (W/m²)

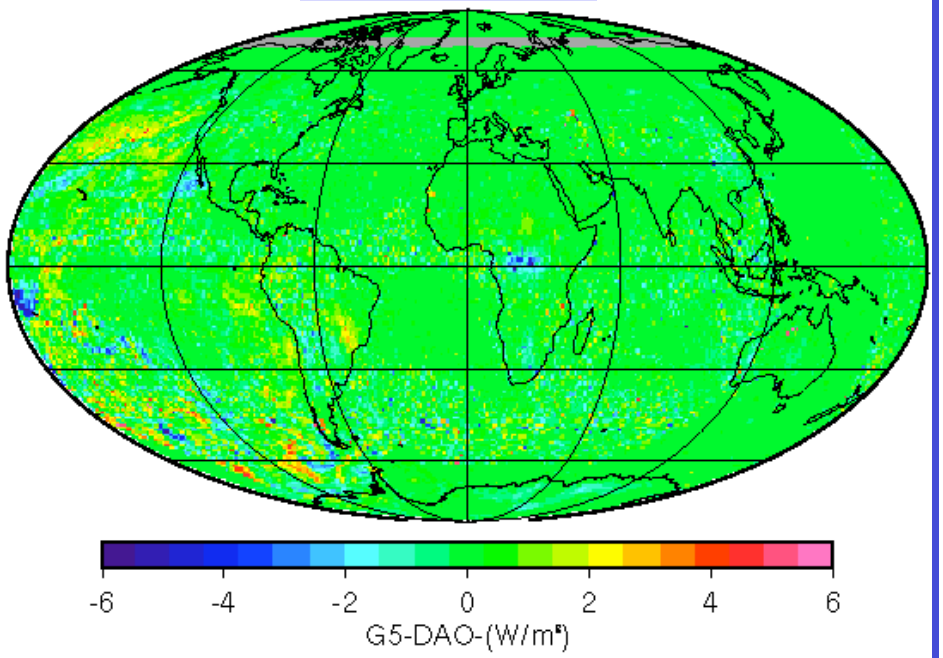
G5-G4 Comparison

G5 impact on the CERES flux product

- How does the GSFC G5 product impact the CERES fluxes?
  - G5 atmospheric profiles could change the ADM scene ID
    - Changes in MODIS derived cloud properties
    - Changes in clear-sky identified MODIS pixels
- How does the G5 profiles impact the GEO derived fluxes?
  - GEO cloud properties more sensitive to G5 profile than MODIS
    - 2 channel retrieval, at night clear-sky determined from predicted TOA clear-sky temperature
  - GEO derived BB fluxes are normalized to CERES fluxes
    - Normalization should work no matter the change in GEO cloud properties
    - Good test of the TISA SW regional normalization algorithm
    - Expect to see minimal global flux difference
- Procedure:
  - Process 3 months of SSF, SFC, GGEO and SRBAVG products using existing algorithms, with G5 input
  - Terra Jan06, Aqua Jan06, and Terra Jul04
- Compare with results SRBAVG Ed2D monthly mean product

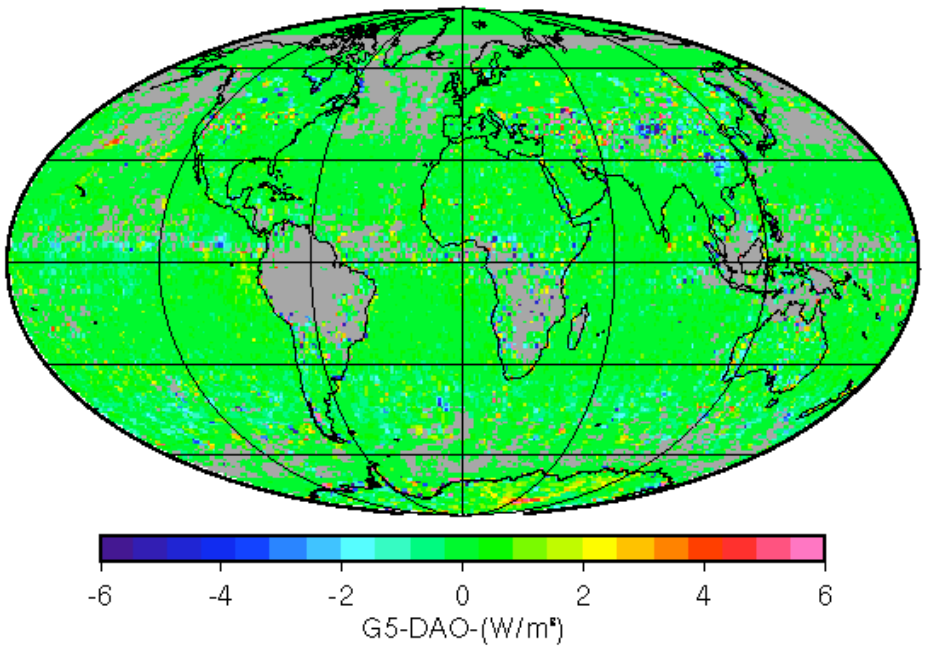
G5 - G4, TOA SW, Aqua Jan06

All-sky GEO



G5	G5-DAO	reg RMS 90N-90S
101.17	0.03	0.73

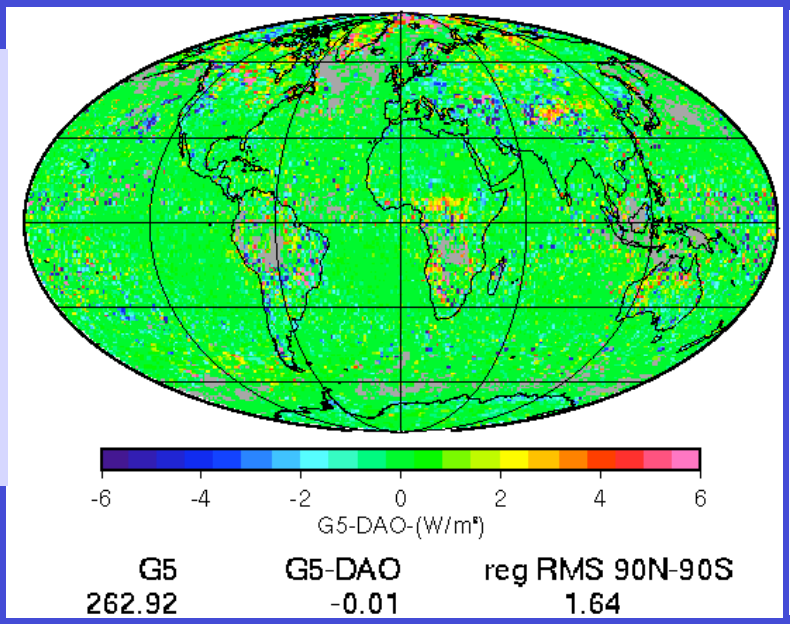
Clear-sky nonGEO

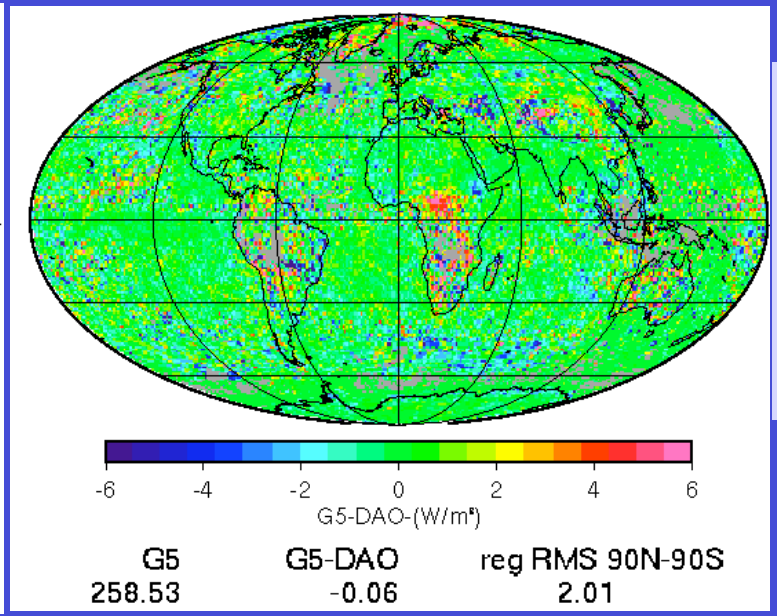


G5	G5-DAO	reg RMS 90N-90S
50.59	0.01	1.17

G5-G4, TOA LW, Aqua Jan06

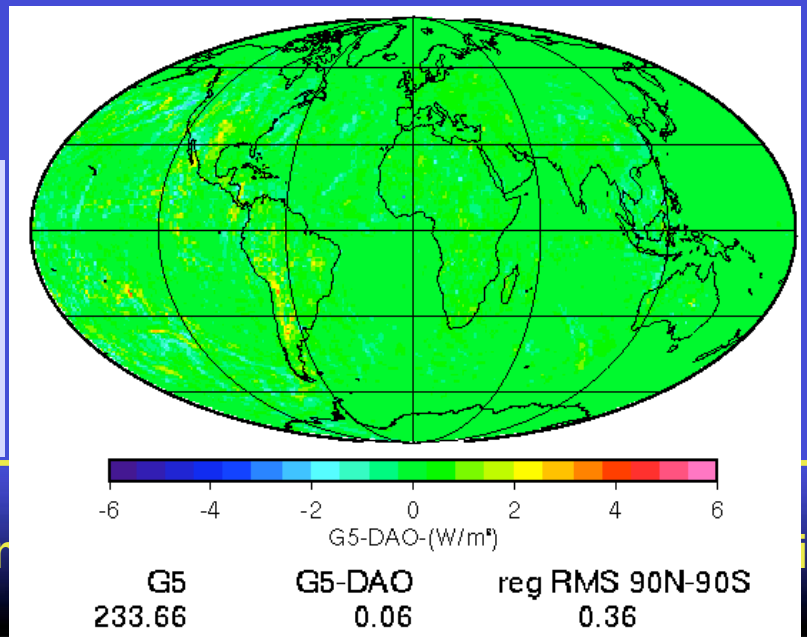
Clear-sky nonGEO





Clear-sky GEO

All-sky GEO



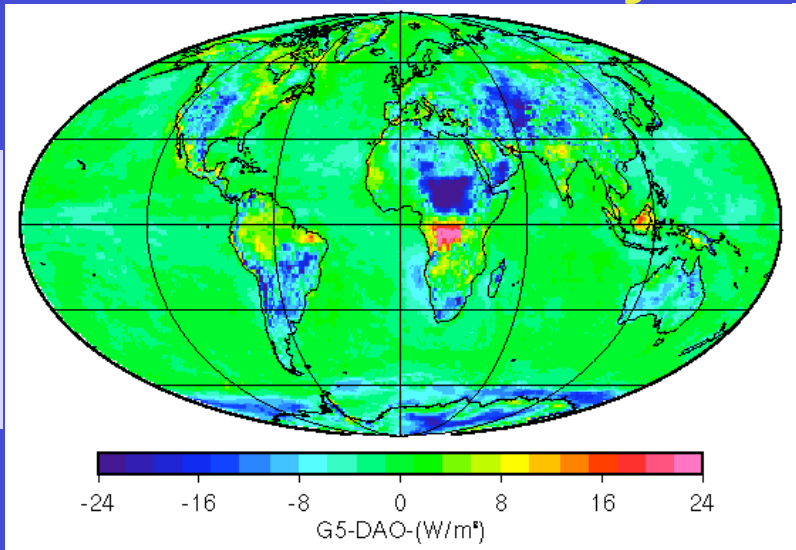
TOA Flux G5-G4 Comparison Table

Bias (Wm^{-2}) RMS	Aqua Jan06	Terra Jan06	Terra Jul04
Clear-sky SW nonGEO 50.5	0.01 1.17	-0.03 1.35	0.02 1.45
Clear-sky LW nonGEO ~263	-0.01 1.64	-0.04 1.59	-0.11 2.00
Clear-sky LW GEO ~259	-0.06 2.01	-0.11 1.97	-0.20 2.40
All-sky SW GEO ~101	0.03 0.73	0.01 0.76	0.02 0.77
All-sky LW GEO ~234	0.06 0.36	-0.02 0.51	0.05 0.55

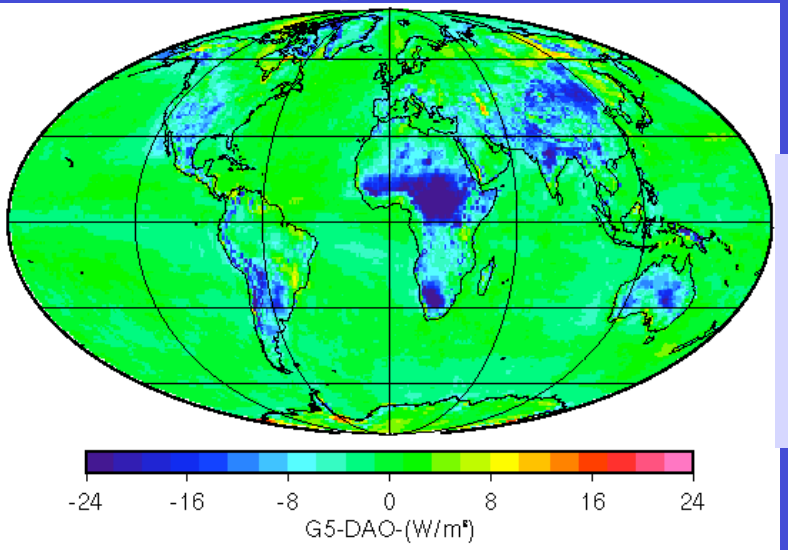
- Note biases < 0.1 Wm^{-2} except for clear-sky LW
- GEO SW regional normalization algorithm is working

G5-G4, All-sky SFC NET LW, Model B

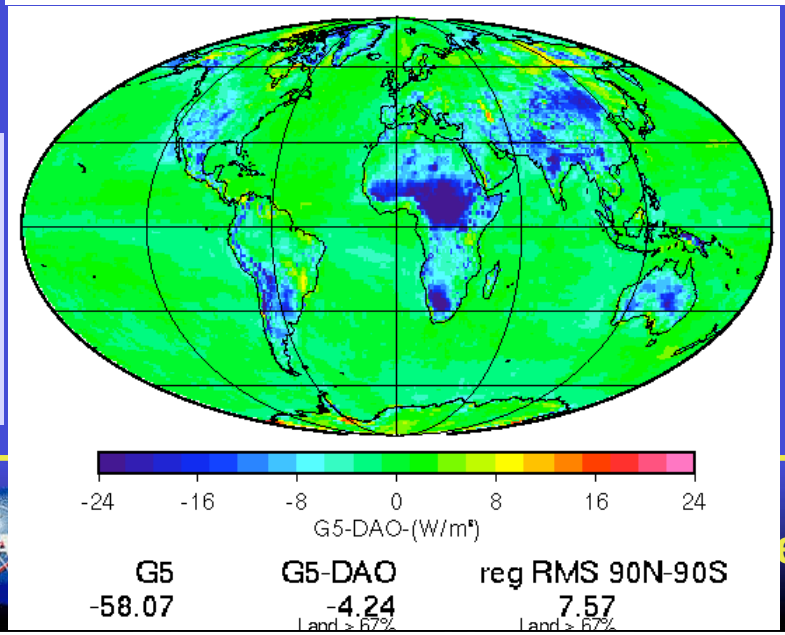
Terra Jul04



Terra Jan06



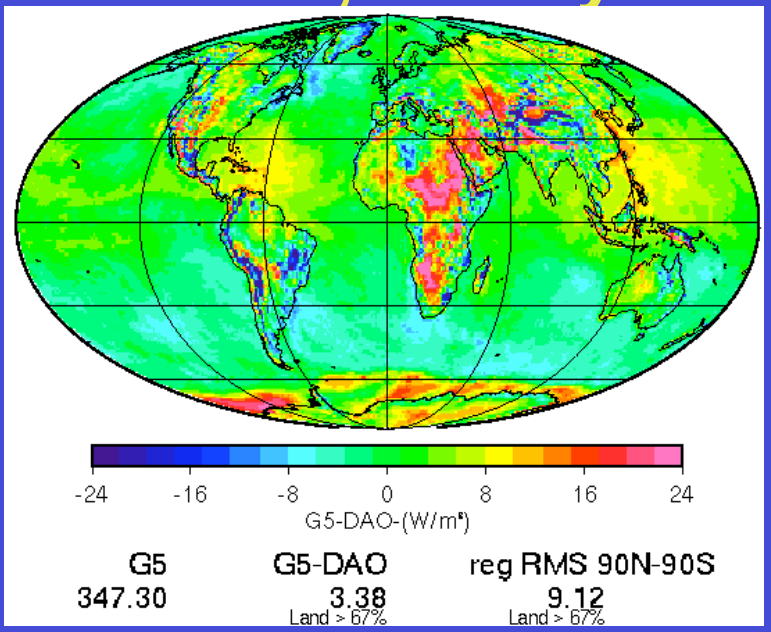
Aqua Jan06

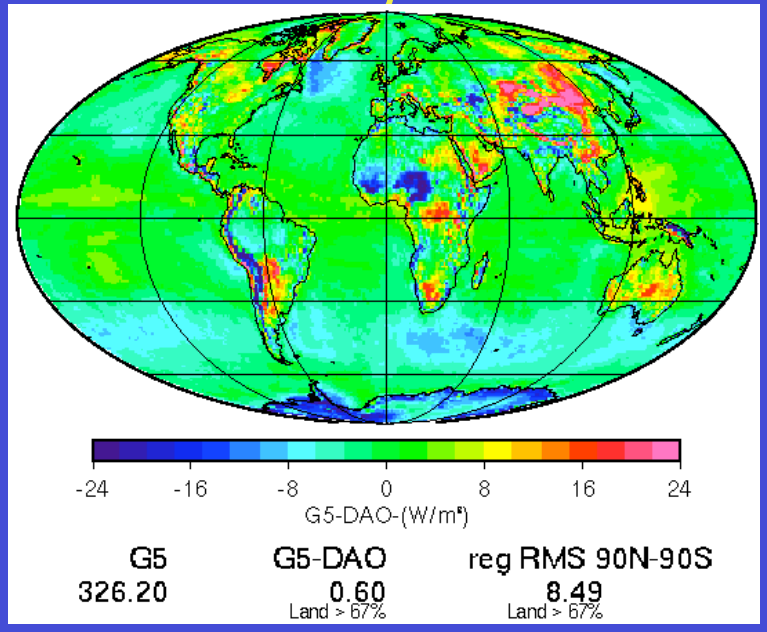


- LW surface fluxes are decoupled from the TOA and depend only on the lower atmosphere and are sensitive to skin temperature differences
- Very similar differences for the clear-sky SFC LW

G5-G4, All-sky SFC Down LW, Model B

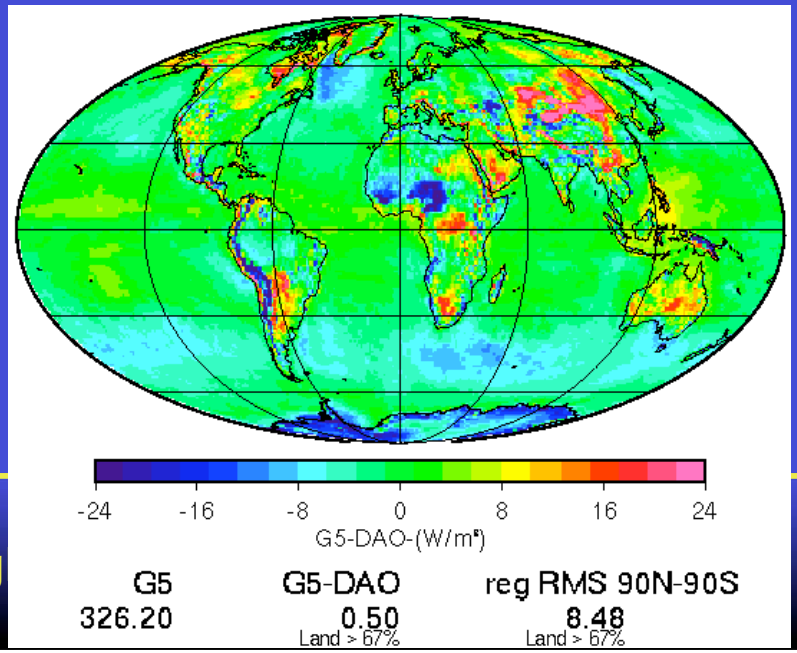
Terra Jul04





Terra Jan06

Aqua Jan06



SFC Flux G5-G4 Comparison Table based on land statistics

Land Bias ModelB Land RMS	Aqua Jan06	Terra Jan06	Terra Jul04
Clear-sky Net SW ~212	0.94 2.23	0.92 2.19	0.00 2.21
All-sky Net SW ~170	0.80 1.98	0.78 1.95	-0.02 1.99
Clear-sky DN SW ~240	0.94 2.22	0.92 2.19	0.02 2.17
All-sky DN SW ~192	0.80 2.04	0.79 2.04	0.01 2.09
Clear-sky Net LW ~ -76	-3.99 7.71	-3.98 7.67	-3.18 7.57
All-sky Net LW ~ -53	-4.24 7.57	-4.22 7.54	-3.86 7.51
Clear-sky DN LW ~322	0.85 8.39	0.95 8.39	4.22 9.35
All-sky DN LW ~ 346	0.50 8.48	0.60 8.49	3.38 9.12

- Some Land SFC SW flux differences are ~ 1Wm^{-2}
- SFC Land LW flux differences are ~ 4Wm^{-2}

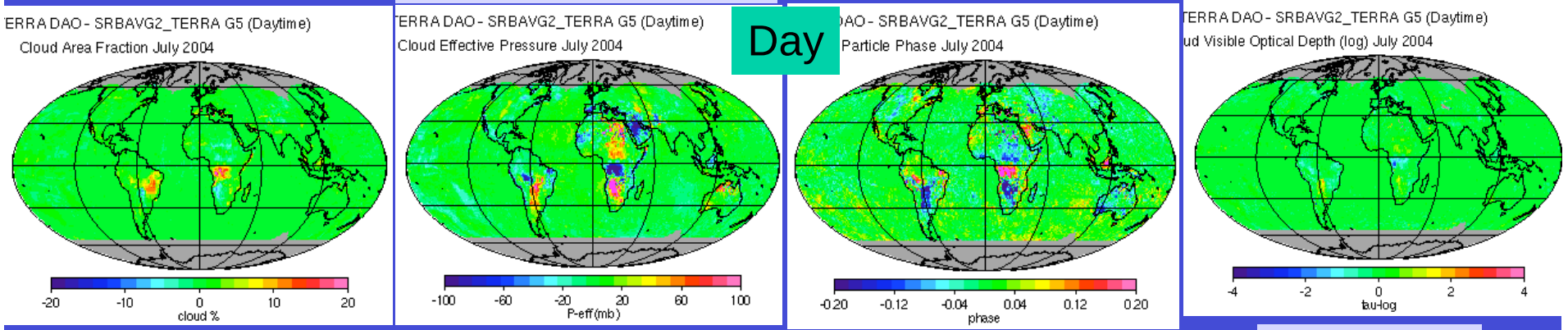
es

CERES

G5-G4 GEO cloud property differences, July 2004

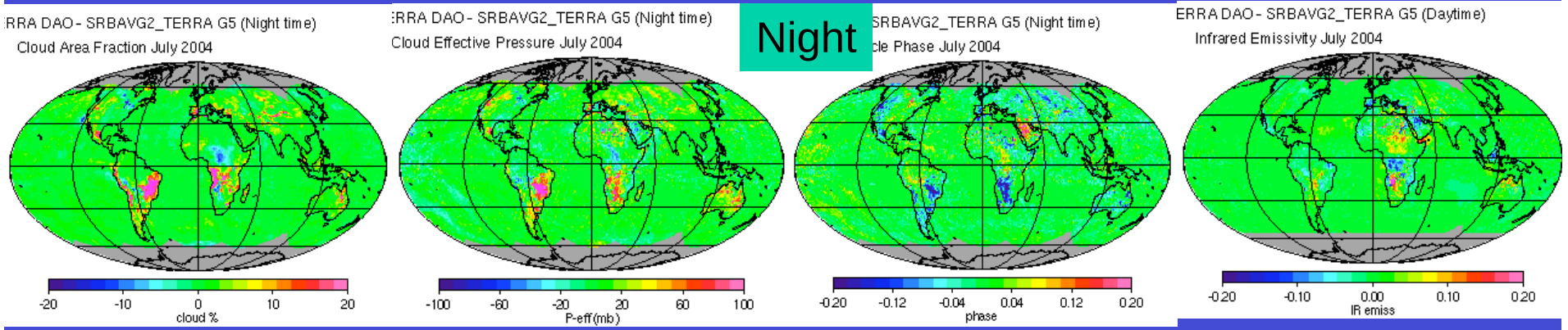
Cloud fraction | Effective Pressure | Cloud Phase | Optical Depth

Day



Emissivity

Night



- Differences are mainly over land, especially over Africa and tropics

G5-G4 GEO cloud property differences, Jan 2006

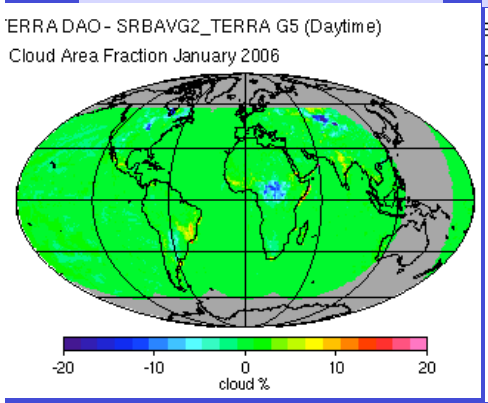
Cloud fraction

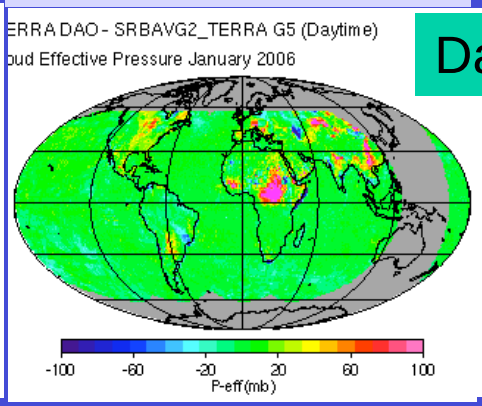
Effective Pressure

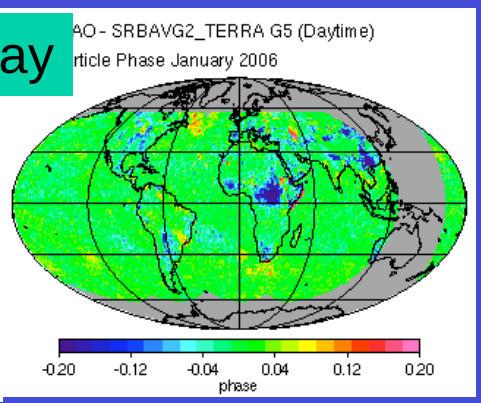
Cloud Phase

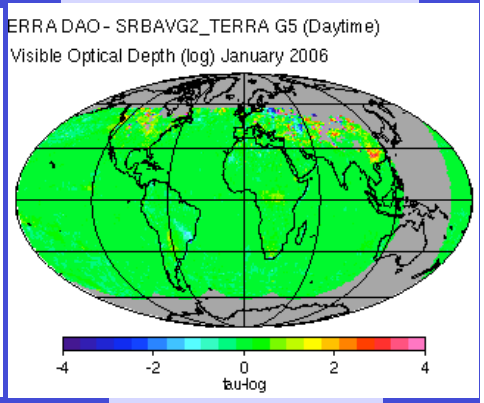
Optical Depth

Day



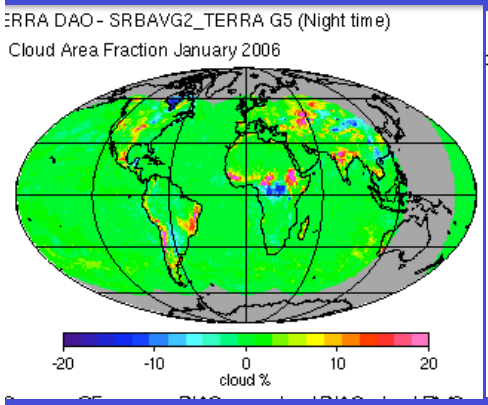


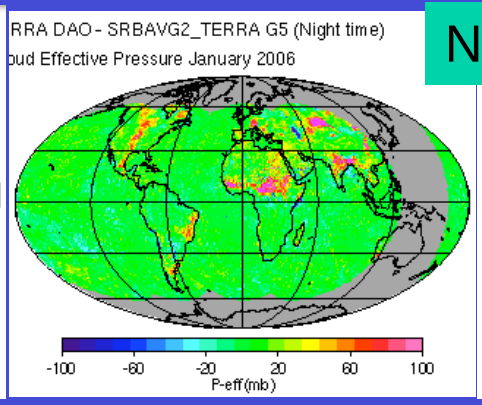


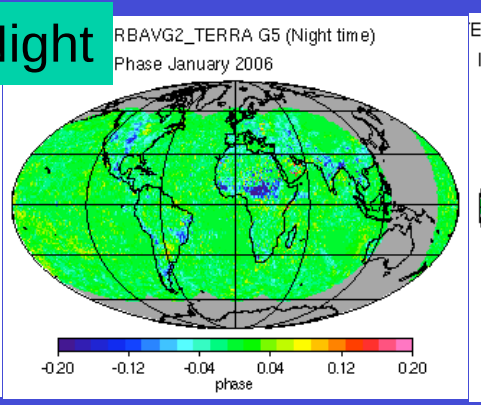


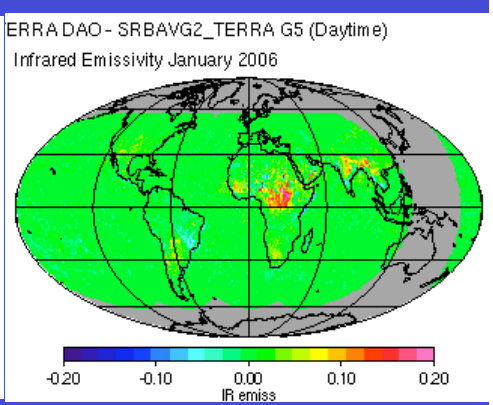
Emissivity

Night

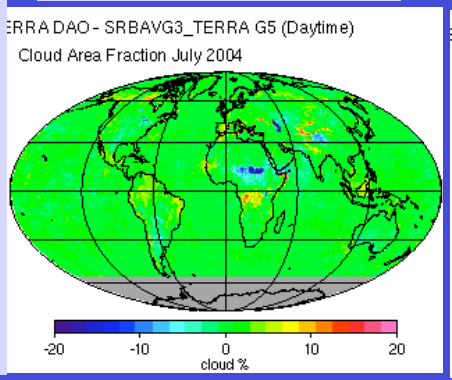
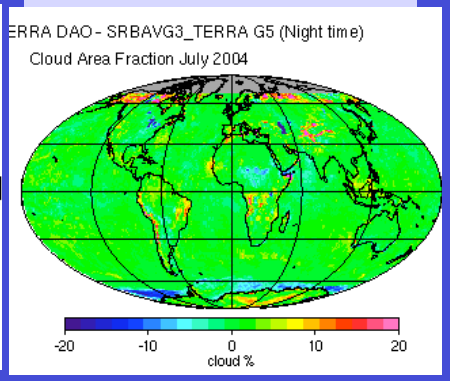
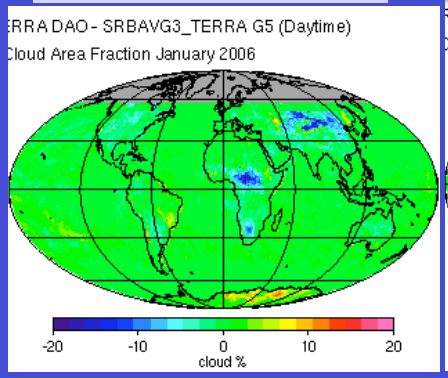
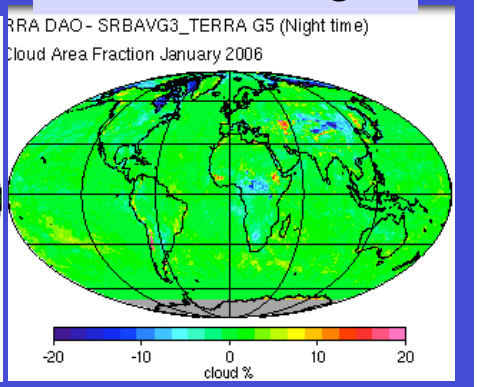
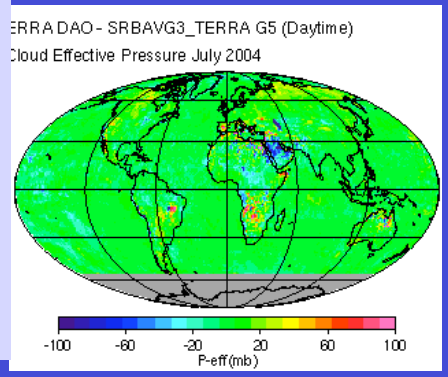
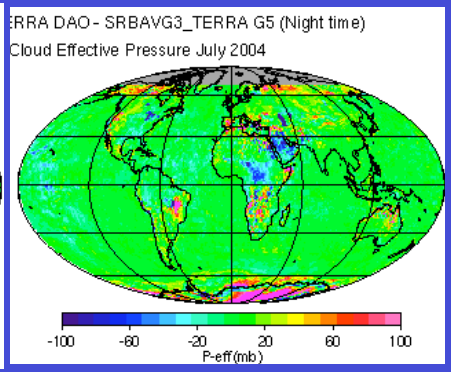
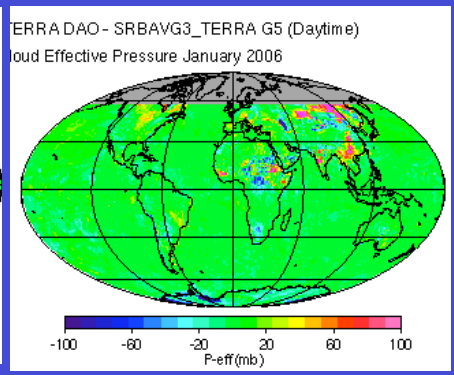
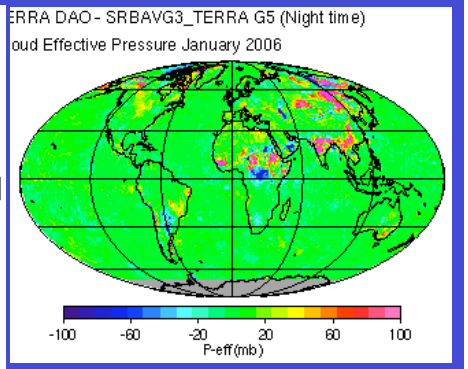
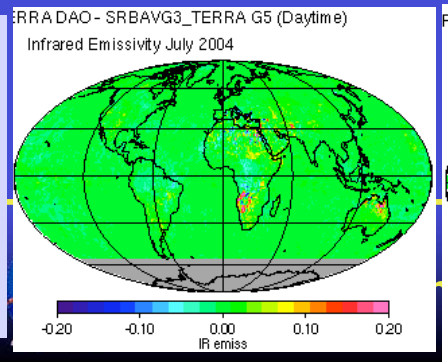
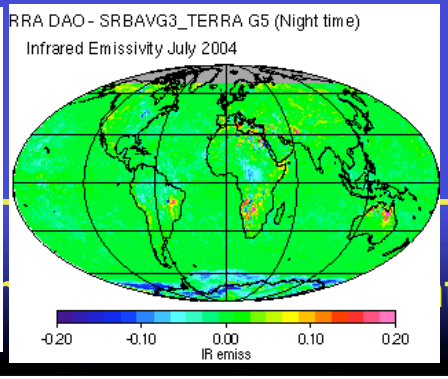
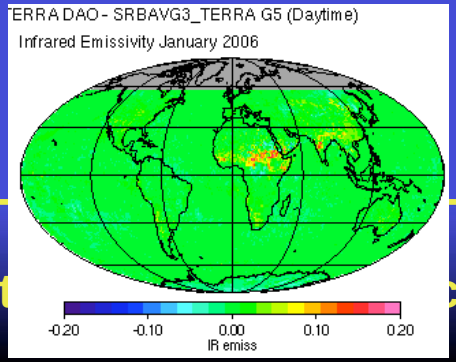
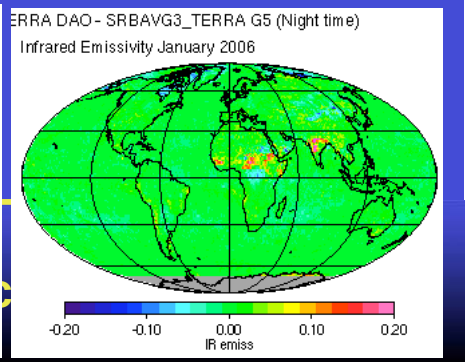








G5-G4 MODIS(CERES) cloud property differences

	July 2004 day	July 2004 night	Jan 2006 day	Jan 2006 night
Cloud amount	 ERRA DAO - SRBAVG3_TERRA G5 (Daytime) Cloud Area Fraction July 2004 -20 -10 0 10 20 cloud %	 ERRA DAO - SRBAVG3_TERRA G5 (Night time) Cloud Area Fraction July 2004 -20 -10 0 10 20 cloud %	 ERRA DAO - SRBAVG3_TERRA G5 (Daytime) Cloud Area Fraction January 2006 -20 -10 0 10 20 cloud %	 RRA DAO - SRBAVG3_TERRA G5 (Night time) Cloud Area Fraction January 2006 -20 -10 0 10 20 cloud %
Eff Pressure	 ERRA DAO - SRBAVG3_TERRA G5 (Daytime) Cloud Effective Pressure July 2004 -100 -60 -20 20 60 100 P-eff(mb)	 ERRA DAO - SRBAVG3_TERRA G5 (Night time) Cloud Effective Pressure July 2004 -100 -60 -20 20 60 100 P-eff(mb)	 ERRA DAO - SRBAVG3_TERRA G5 (Daytime) loud Effective Pressure January 2006 -100 -60 -20 20 60 100 P-eff(mb)	 ERRA DAO - SRBAVG3_TERRA G5 (Night time) oud Effective Pressure January 2006 -100 -60 -20 20 60 100 P-eff(mb)
Emissivity	 ERRA DAO - SRBAVG3_TERRA G5 (Daytime) Infrared Emissivity July 2004 -0.20 -0.10 0.00 0.10 0.20 IR emiss	 RRA DAO - SRBAVG3_TERRA G5 (Night time) Infrared Emissivity July 2004 -0.20 -0.10 0.00 0.10 0.20 IR emiss	 ERRA DAO - SRBAVG3_TERRA G5 (Daytime) Infrared Emissivity January 2006 -0.20 -0.10 0.00 0.10 0.20 IR emiss	 ERRA DAO - SRBAVG3_TERRA G5 (Night time) Infrared Emissivity January 2006 -0.20 -0.10 0.00 0.10 0.20 IR emiss

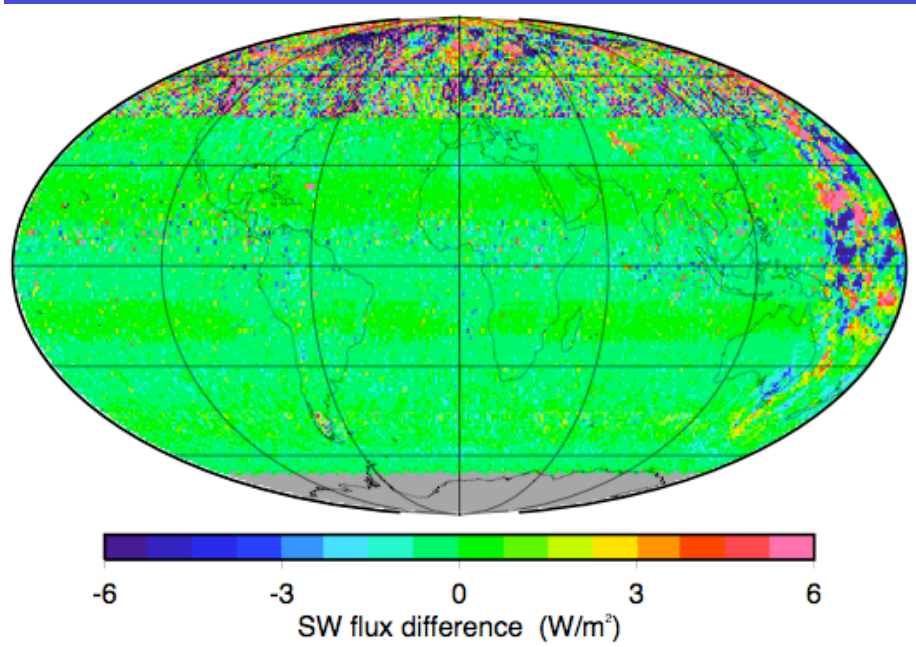
Adjusted SRBAVG fluxes

Net Flux Optimal Global Closure

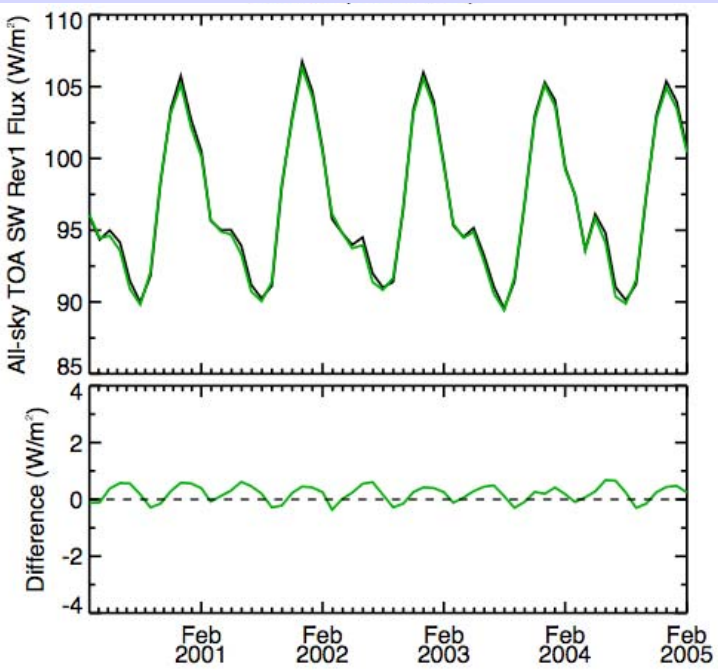
- Objective is to close the net flux imbalance by adjusting SW & LW TOA fluxes according to known uncertainties.
  - Norm will address topic in following presentation
  - Mainly instrument uncertainty
  - Apply instantaneous uncertainty adjustments to Norm's SSF-daily database to derive monthly mean regional adjustment
  - Apply regional adjustments to the SRBAVG GEO product as final output
  - Able to sidestep CERES production, process 5 years in 1 day
- Opportunity to validate TISA temporal averaging
  - Compare monthly means from Norm's daily SSF database with SRBAVG nonGEO fluxes
  - SSF database comprised of (GMT) daily gridded day and night flux means from SSF
  - Norm first derives SSF daily SW fluxes and then averages all footprint daily fluxes for the day including regions with multiple measurement times
  - SRBAVG first spatially averages the footprint fluxes and then uses the mean cloud property directional model to interpolate between gridded measurements
  - SSF database averages all LW footprints for the day regardless of multiple overpasses, SRBAVG interpolates between measurement times

SSFdaily - nonGEO TOA SW flux

SSFdaily - nonGEO All-sky SW flux, July 2002



SSFdaily - nonGEO All-sky global SW flux timeline



All-sky TOA SW Rev1		Difference	Avg
CERES	96.91	CERES - nonGEO	0.20
nonGEO	96.71		

5-Year Annual Flux Means

60 month mean		SSF-daily	nonGEO
Clear LW	linear	267.26	267.05
	half-sine	266.68	266.41
All-sky LW	linear	238.33	237.90
	half-sine	237.65	237.70
Clear SW		51.35	51.24
All-sky SW		96.91	96.71

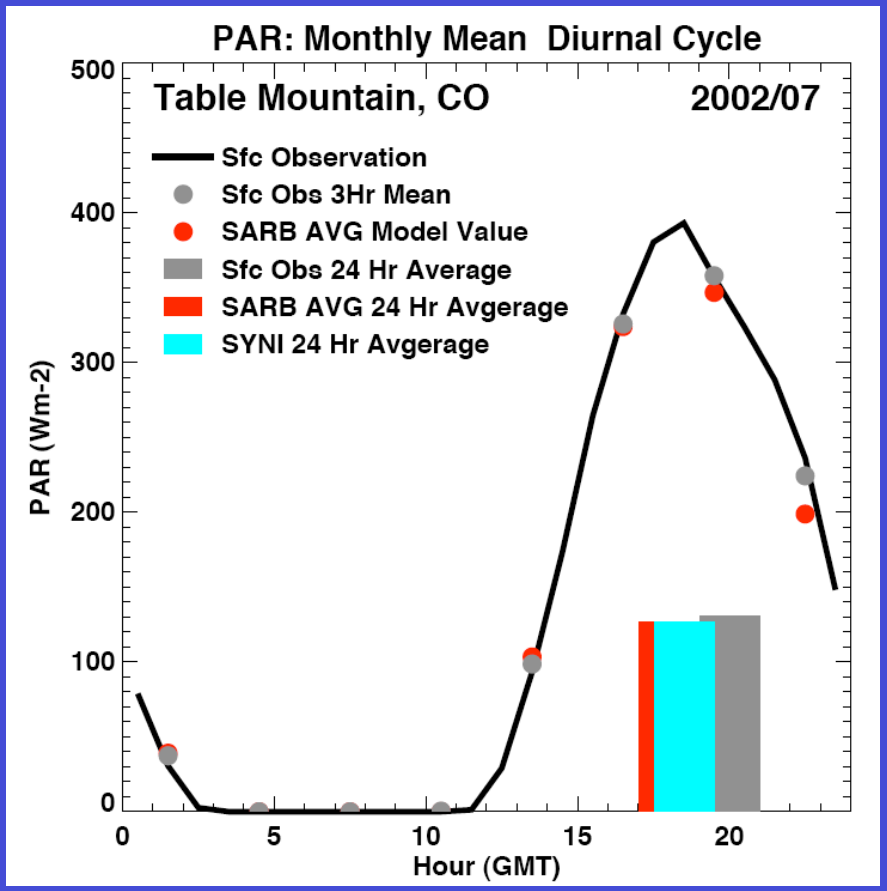
- Two independent approaches giving similar global means

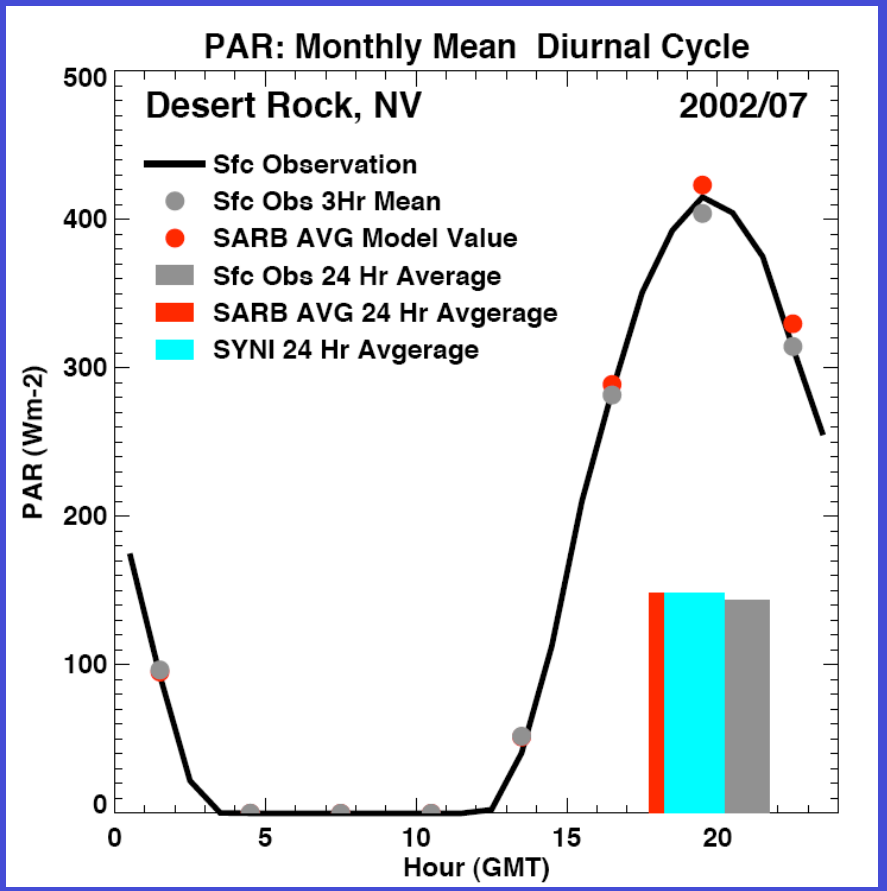
SYN/AVG/ZAVG products

TSI/SYNI/SYN/AVG/ZAVG SARB Product

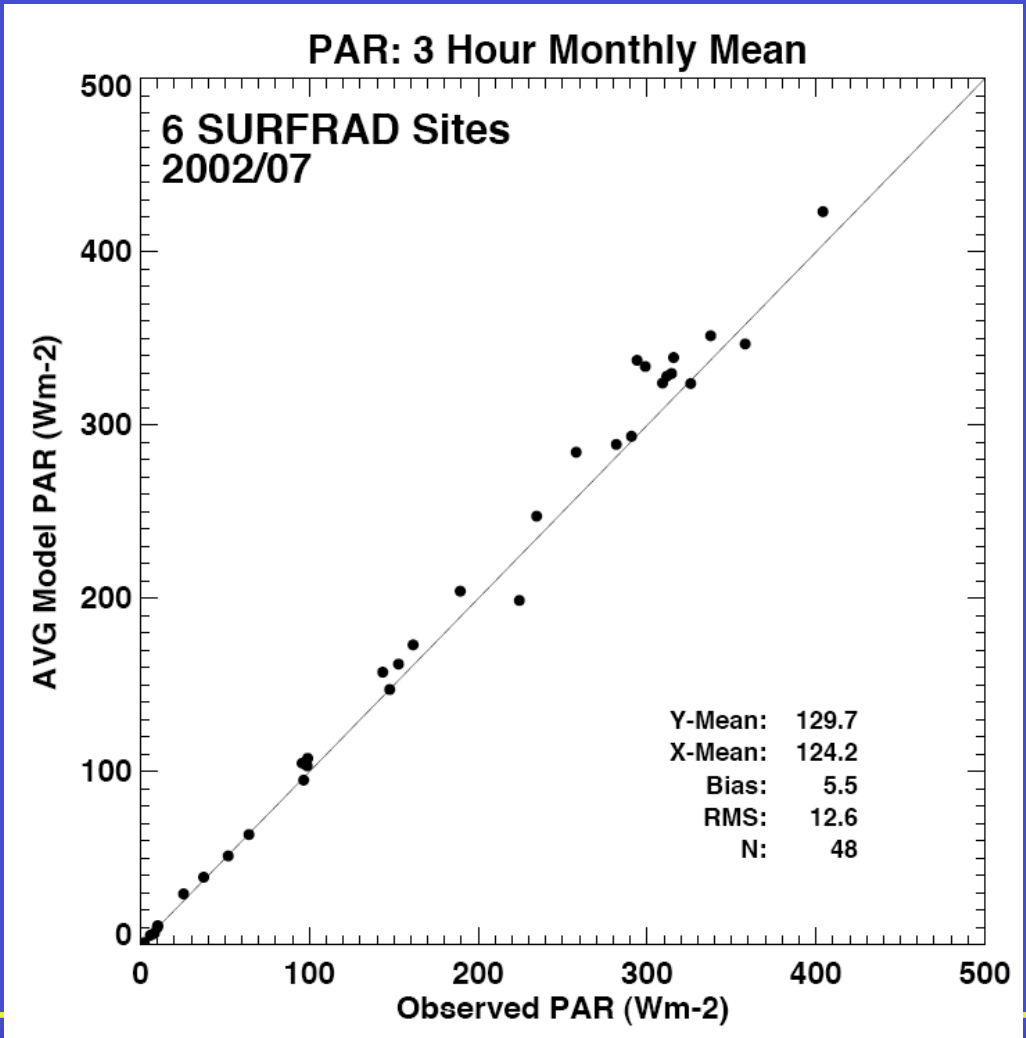
- Beta4 Code delivered to the DAAC
  - Code deliveries now required work both on SGI and cluster
  - TSI (Dec07), SYN (Dec07), SYN/AVG/ZAVG (Feb08)
  - TSI code has not been promoted, Magneto environment issues
  - SYN/AVG/ZAVG takes ~ 3 days to process, working on optimizing the code
  - If no other major problems allow six weeks for testing (mid June)
- Beta4 process all the seasonal months for both Aqua (Jul02-Oct05) and Terra (Apr00-Oct05) to monitor any long-term artifacts
  - Make sure that SRBAVG = ZAVG global monthly means
  - Best case scenario, 1.5 months, evaluate 1 month, (end Aug)
- Should be an Edition2 product by the end of 2008 in order to meet Terra/Aqua senior review funding requirements
  - Given no show stoppers, 4 months to process entire record, (end Dec)

Comparison of SYN/AVG and SURFRAD PAR fluxes, Terra July 2002 product





Comparison of SYN/AVG and SURFRAD PAR monthly 3-hourly fluxes, Terra July 2002 product



• Surfrad sites: Bondville, IL; Desert Rock, NV, Fort Peck, MT; Goodwin Creek, MS; Penn State, PA; Table Mountain, CO

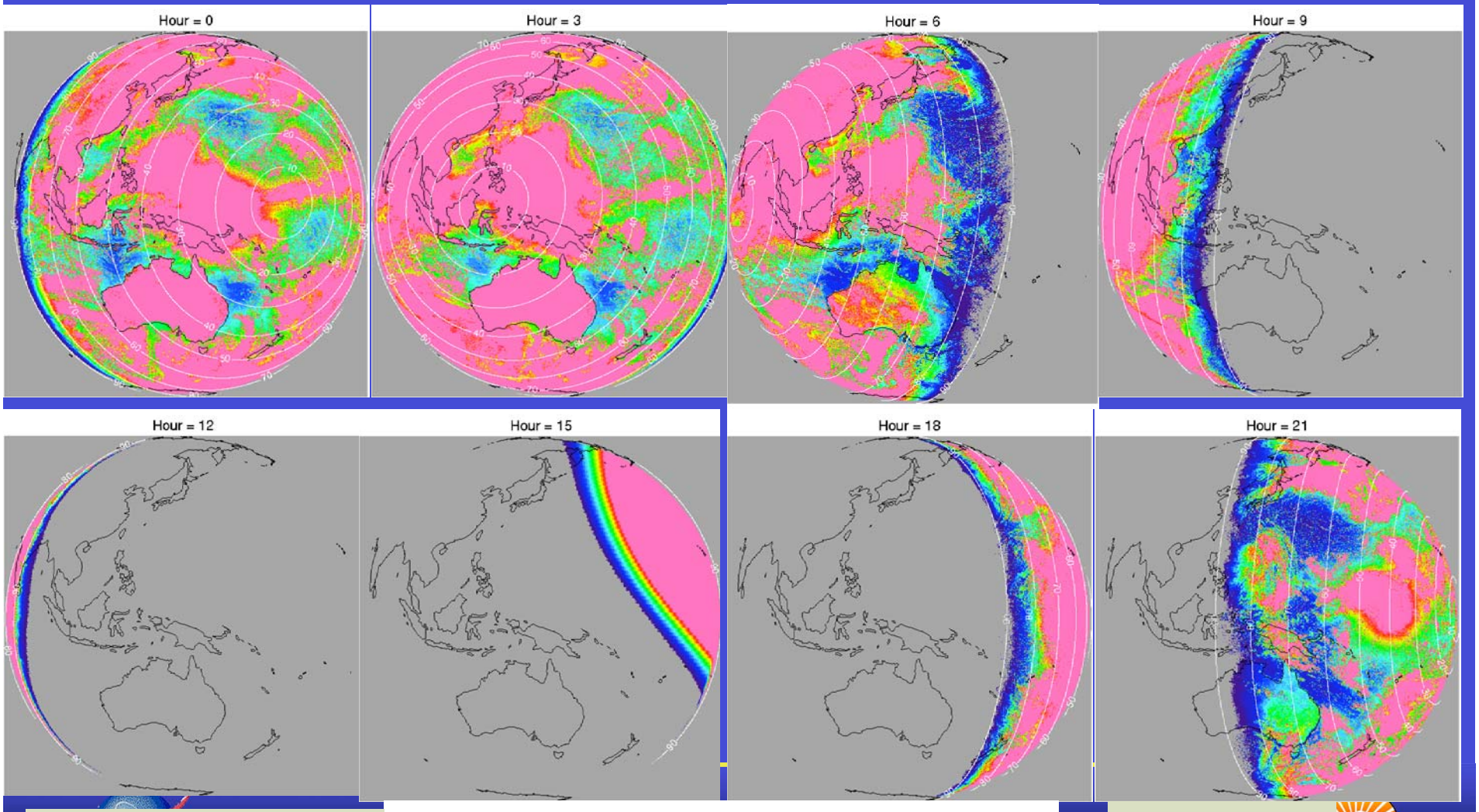
GGEO MTSAT status

MTSAT issues delaying GGEO processing

- MTSAT cloud properties matched at Terra times were vastly different then for GOES-9 or GMS-5
  - Increase in clear-sky amount for regions with large SZA
  - Noticed that many regions near the terminator had counts or radiances=0 even though the SZA<90°
  - Noticed a nonlinear response that resulted in negative radiances for low count scenes.
    - Working with Don Garber to either use a dual linear or hyperbolic fit when regressing coincident ray-matched Terra/MTSAT radiances
    - Applying lessons learned with Terra and Aqua to VIRS/MTSAT matches to make sure that all SZA are well calibrated
- MTSAT images were reformatted
  - McIDAS ingested MTSAT images from Nov05-Aug07 using the GMS-5 receiving equipment
  - Used JPEG compression to reduce resolution from 4 to 5km and from 10bit linear to 8bit squared visible count to radiance relationship
  - From Sep07 to present receiving nominal resolution images
  - Develop calibration technique with 10bit data and then apply to 8bit

• Note that many terminator MTSAT pixels have counts of 0 when the SZA<90°

MTSAT VIS, Sept 17, 2007

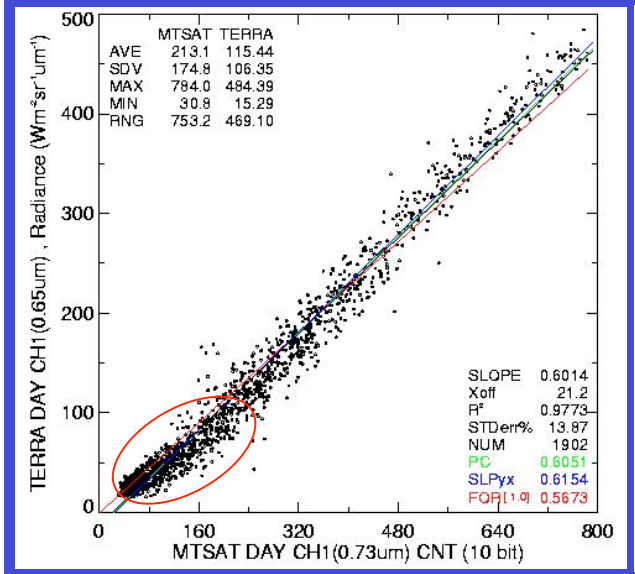


Space count=0

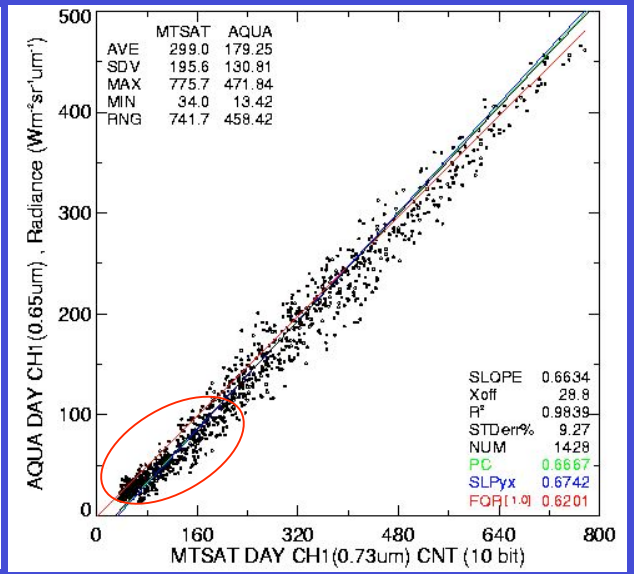
10bit VIS

MTSAT 10bit visible calibration, Sep 2007

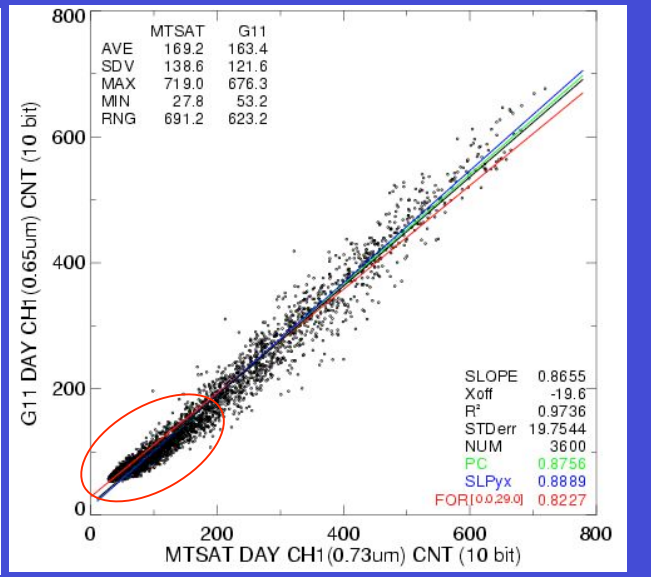
MTSAT/Terra



MTSAT/Aqua



MTSAT/GOES11

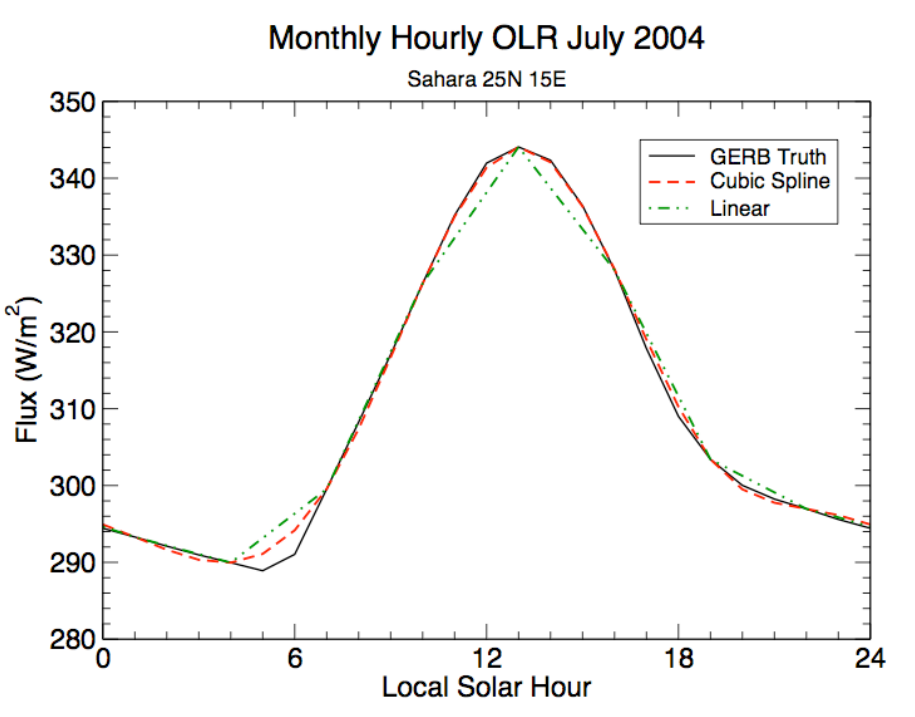


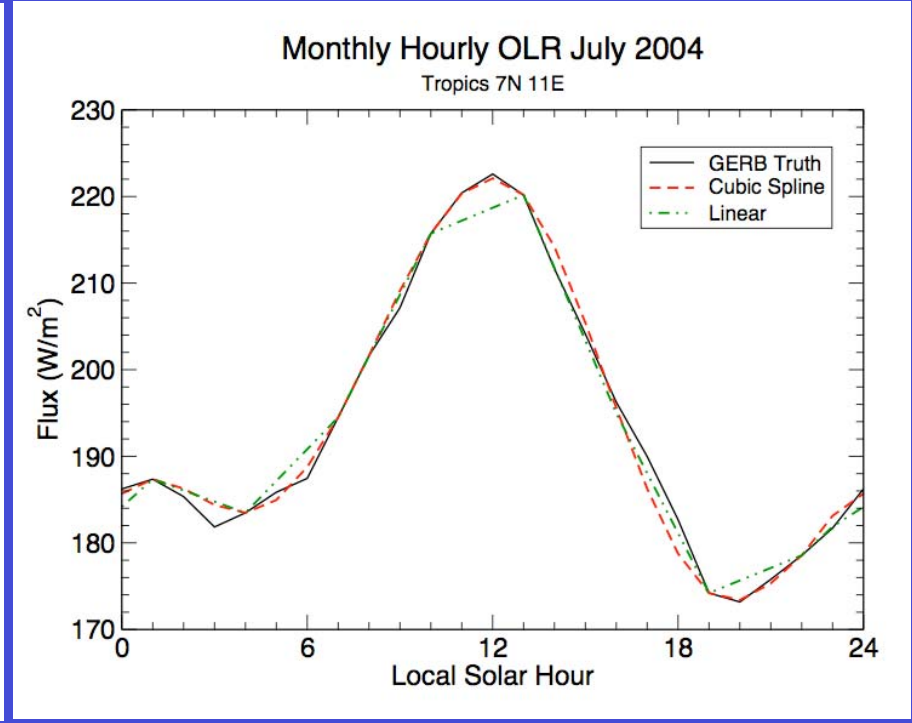
Edition3 improvements

Edition 3 improvements

- LW NB-BB and ADM improvements
  - Develop LW NB-BB model using ADM binning and LW 5° regional normalization similar to GEO derived BB SW
  - Currently using one global parameterization using NB flux and column RH humidity and instantaneous normalization
- LW cubic spline interpolation over land
  - To estimate peak daytime flux using 3-hourly sampling
- Improvements in the clear-sky GEO mask
  - Clear-sky scene identification weakest part of GEO cloud retrieval algorithm
  - Derive clear-sky albedo maps from GEO (now using monthly MODIS clear-sky maps)
  - Mitigate effects of dark cold scenes being classified as clear-sky in GEO algorithm

LW land cubic spline interpolation





- Truth are 1-hourly GERB measurements
- Interpolation performed on 3-hourly measurements
- Cubic spline captures the daytime heating peak given 3-hourly fluxes
- Linear always underestimates the truth near noon

Comparison of monthly hourly GEO LW flux bias

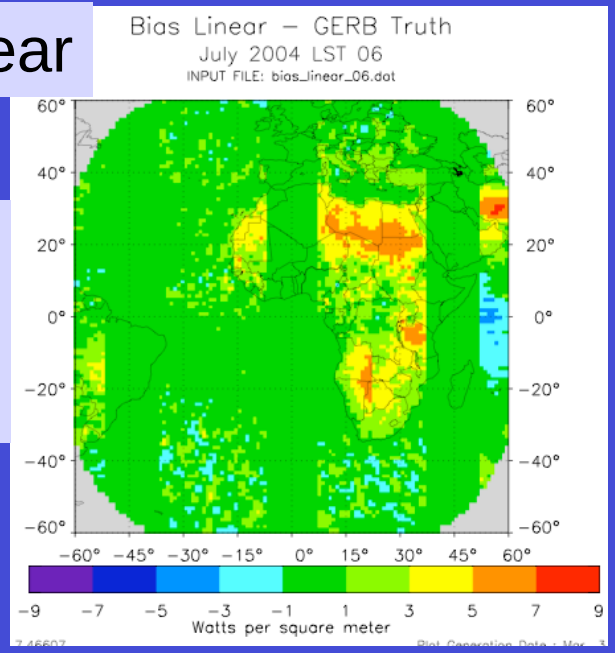
Linear

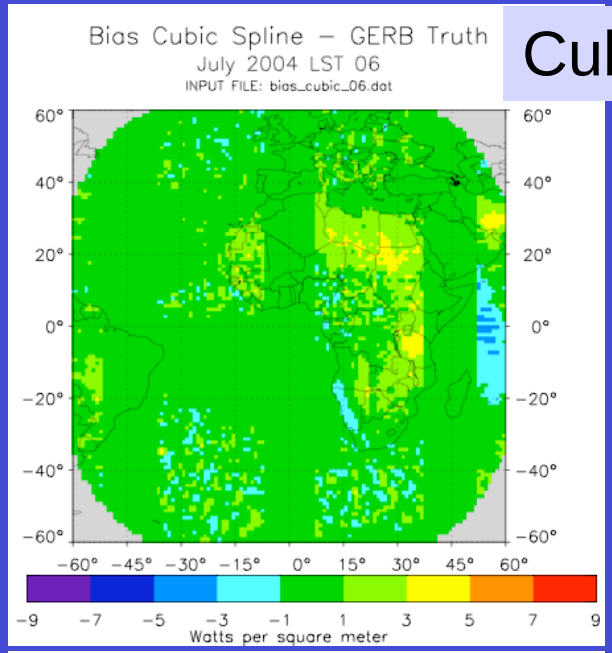
Cubic spline

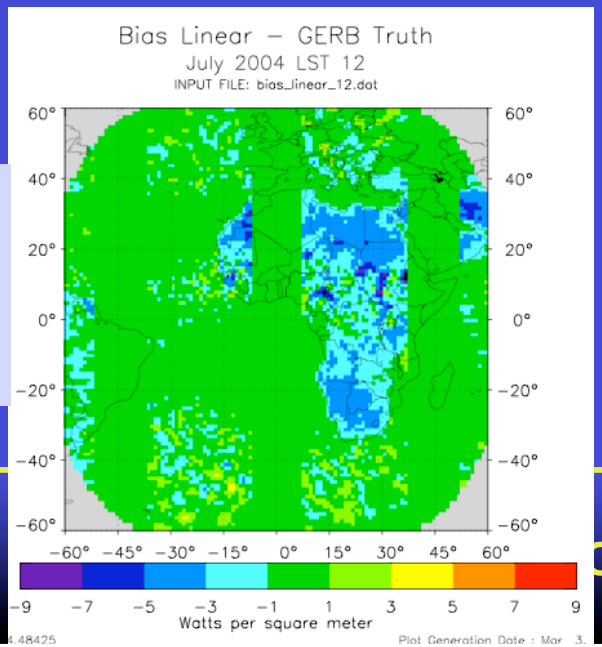
06 LST

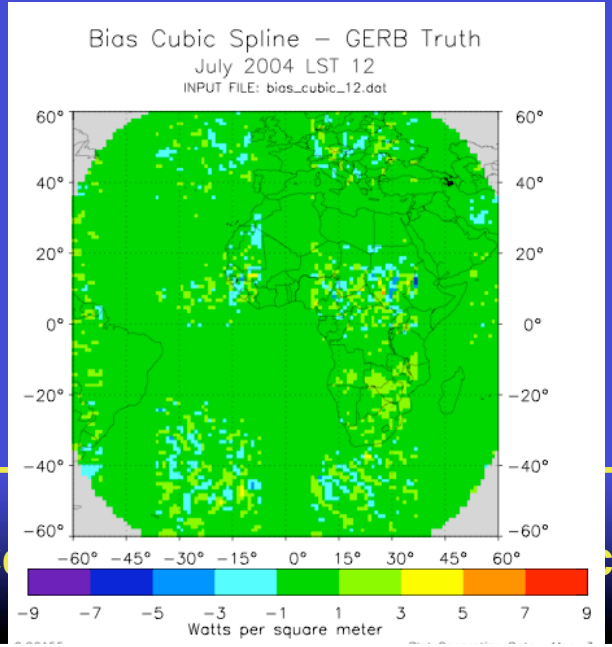
12 LST

July 2004



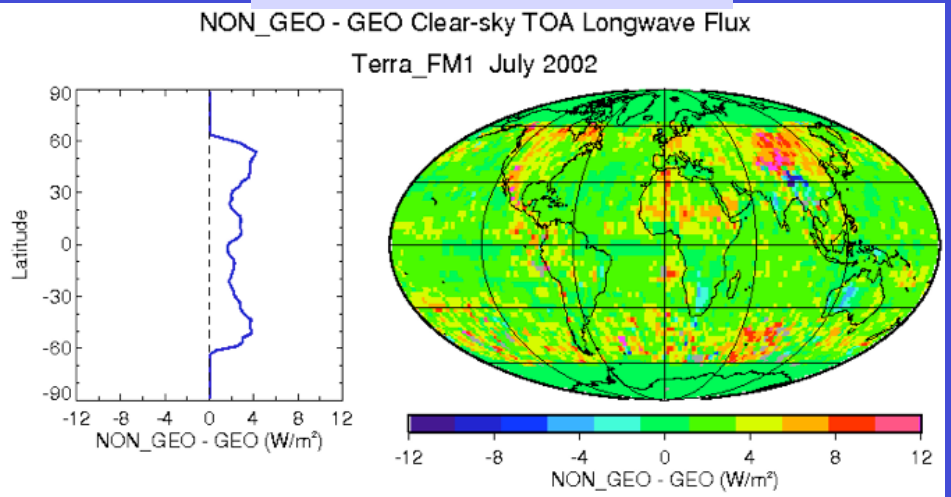






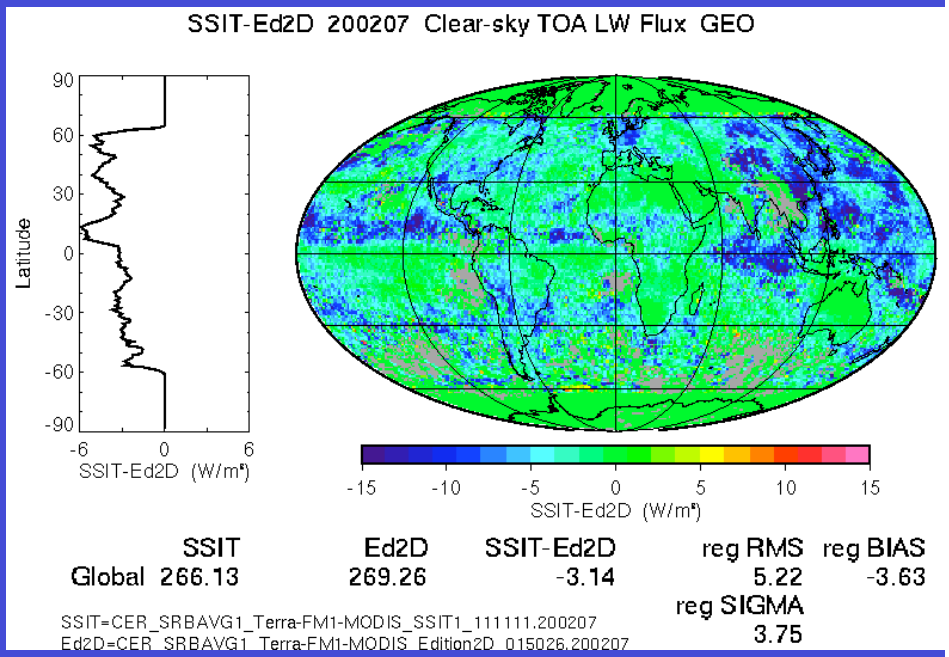
GEO clear-sky LW, July 2002

nonGEO - GEO



	NON_GEO	GEO	Bias
Global	271.5	269.2	2.3
60N-60S	279.9	277.2	2.6
30N-30S	288.6	286.4	2.2

GEO (use all obs) - GEO



	SSIT	Ed2D	SSIT-Ed2D	reg RMS	reg BIAS
Global	266.13	269.26	-3.14	5.22	-3.63

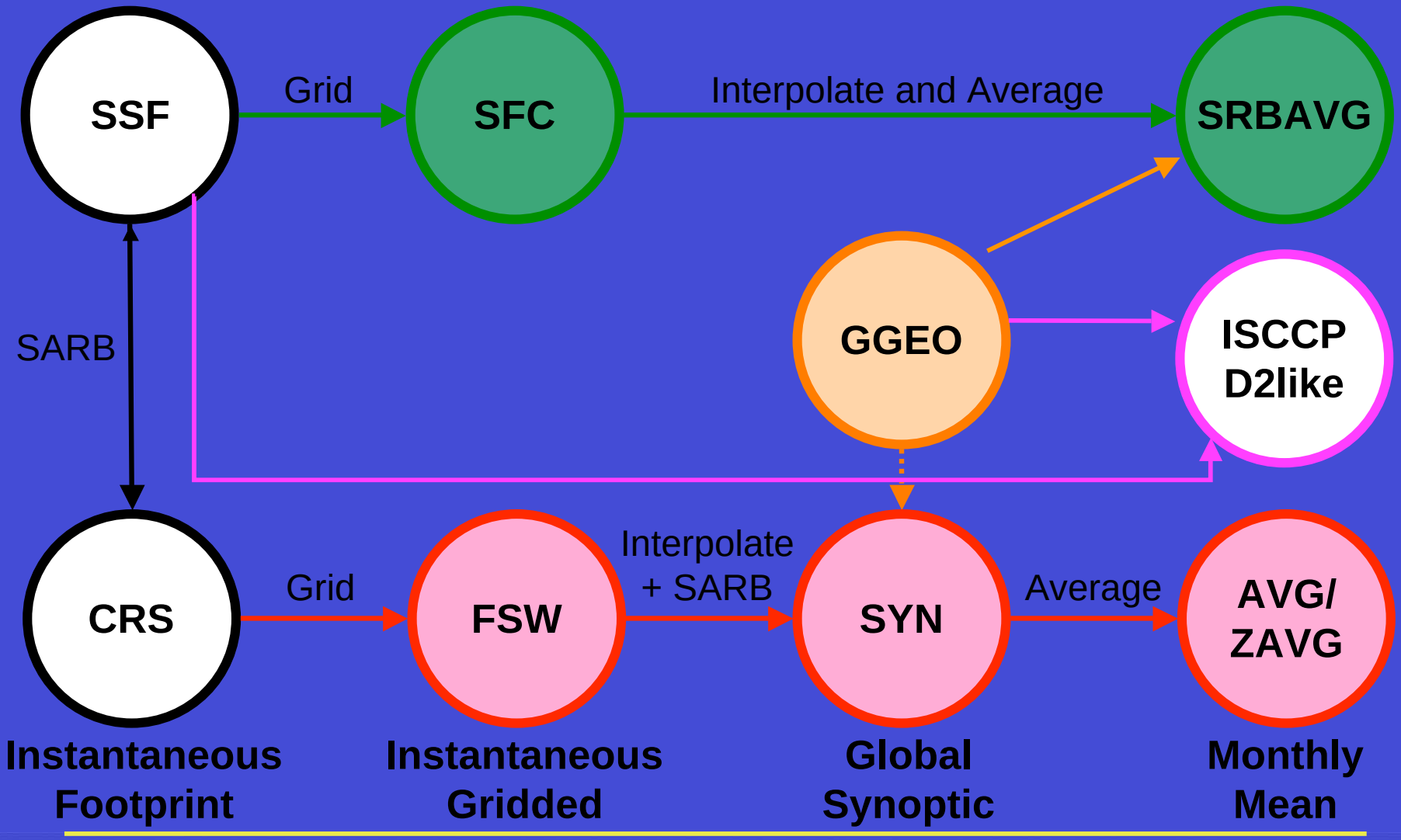
reg SIGMA 3.75

SSIT=CER_SRBAVG1_Terra-FM1-MODIS_SSIT1_111111.200207
Ed2D=CER_SRBAVG1_Terra-FM1-MODIS_Edition2D_015026.200207

- GEO clear-sky monthly mean LW is computed from days with CERES measurements only, same days as the nonGEO product
- Right panel difference plots shows the effect of using all GEO measurements days instead of only the CERES measurement days
- Greatest difference occurs in very cloudy regions
- GEO clear-sky retrievals not as robust as MODIS using only a VIS and IR channel

TISA Schedule

CERES Advanced TISA Processing



Terra CERES Edition Products

- CERES Edition table *(link in the TISA DQS)*
  - http://eosweb.larc.nasa.gov/PRODOCS/ceres/edition2_product_versions.html

Edition2	Terra SSF	Terra SFC	Terra SRBAVG
A	SSF_Edition2A	SFC_Edition2A. SFC Edition2A Cautions	
B	SSF_Edition2B ADM improvements	SFC_Edition2B. SFC Edition2B Cautions	
C	SSF_Edition2B	SFC_Edition2C	SRBAVG_Edition2C no GEO SW fluxes
D	SSF_Edition2B	SFC_Edition2C	SRBAVG_Edition2D GEO SW fluxes provided SRBAVG Edition2D Cautions
E	SSF_Edition2B (end April 2006)	SFC_Edition2C	* SRBAVG_Edition2E
F	SSF_Edition2F (begin May 2006) MODIS collection 5	SFC_Edition2F code=Terra_SFC_Edition2C	* SRBAVG_Edition2F code=Terra_SRBAVG_Edition2E

Edition2	Terra SSF	Terra CRS	Terra FSW	Terra SYN/AVG/ZAVG
A	SSF_Edition2A	CRS_Edition2A		
B	SSF_Edition2B ADM improvements	CRS_Edition2B CRS improvements		
C	SSF_Edition2B (end April 2006)	CRS_Edition2B	FSW_Edition2C	SYN-AVG-ZAVG Beta3. * AVG_Edition2C
F	SSF_Edition2F (begin May 2006) MODIS collection 5	CRS_Edition2F code=Terra_CRS_Edition2B	FSW_Edition2F code=Terra_FSW_Edition2C	* AVG_Edition2F code=Terra_AVG_Edition2C

* projected
products are consistent across an Edition2 letter or row in the table
code= refers to the product code used to process the named Edition2 product

Aqua CERES Edition Products

- CERES Edition table *(link in the TISA DQS)*
  - http://eosweb.larc.nasa.gov/PRODOCS/ceres/edition2_product_versions.html

Edition2	Aqua SSF	Aqua SFC	Aqua SRBAVG
A	SSF_Edition2A Error in Model B SW sfc fluxes	SFC_Edition2A code=Terra_SFC_Edition2C	SRBAVG_Edition2A code=Terra_SRBAVG_Edition2D SRBAVG Edition2A Cautions
B	SSF_Edition2B (end April 2006) Corrected Model B SW sfc fluxes	SFC_Edition2B code=Terra_SFC_Edition2C	* SRBAVG_Edition2B code=Terra_SRBAVG_Edition2E
C	SSF_Edition2C (begin May 2006) MODIS collection 5	SFC_Edition2C code=Terra_SFC_Edition2C	* SRBAVG_Edition2C code=Terra_SRBAVG_Edition2E

Edition2	Aqua SSF	Aqua CRS	Aqua FSW	Aqua SYN/AVG/ZAVG
A	SSF_Edition2A Error in Model B SW sfc fluxes	CRS_Edition2A	FSW_Edition2A code=Terra_FSW_Edition2C	
B	SSF_Edition2B (end April 2006) Corrected Model B SW sfc flux	CRS_Edition2B CRS improvements	FSW_Edition2B code=Terra_FSW_Edition2C	* AVG_Edition2B code=Terra_AVG_Edition2C
C	SSF_Edition2C (begin May 2006) MODIS collection 5	CRS_Edition2C code=Aqua_CRS_Edition2B	FSW_Edition2C code=Terra_FSW_Edition2C	* AVG_Edition2C code=Terra_AVG_Edition2C

* projected
products are consistent across an Edition2 letter or row in the table
code= refers to the product code used to process the named Edition2 product

CERES spatially gridded and temporally averaged (level 3) products

- ERBE-like
  - TOA Fluxes based on ERBE (scene id, ADM) algorithms and output format
  - Instantaneous, daily, monthly hourly (ES-9), monthly means (ES-9, ES-4)
  - Terra Ed2 (Mar00-Dec06), Ed1CV (2 month lag)
  - Aqua Ed2 (Jul02-Dec06), Ed1CV (2 month lag)
- SFC
  - Instantaneous gridded (SSF) CERES footprint TOA and surface fluxes, clouds and aerosols, output in local time
  - Terra Ed2 (Mar00-Dec06)
  - Aqua Ed2 (Jul02-Dec06)
- FSW
  - Instantaneous gridded (SSF & CRS) radiative transfer modeled profile fluxes consistent with CERES TOA fluxes, clouds and aerosols, output in GMT time
  - Terra Ed2 (Mar00-Dec06)
  - Aqua Ed2 (Jul02-Dec06)
- Extend ERBE-like, SFC and FSW, datasets to Dec07
  - First to Aug07, processing takes 6-9 months after instrument coefficient delivery
  - Second to Dec07, currently no plans for 2008, Use GEOS-5 in 2008

CERES spatially gridded and temporally averaged (level 3) products

- ISCCP-like-MODIS (new)
  - Pc-Tau stratified (SSF) MODIS retrieved cloud properties
  - Similar to ISCCP-D2 output of monthly GMT 3-hourly and means
  - Terra Ed2 (process Mar00-Dec06, due Fall 2008)
  - Aqua Ed2 (process Jul02-Dec06, due Fall 2008)
  - Extend to Dec07 on same schedule as SFC
- ISCCP-like-GEO (new)
  - Pc-Tau stratified 5-geostationary imager retrieved cloud properties
  - GEO (process Mar00-Oct05, due Dec 2008)
- SRBAVG
  - Temporally averaged gridded, zonal and global TOA and surface fluxes, clouds and aerosols, output in local time as monthly hourly and monthly means
  - nonGEO product contains CERES fluxes and clouds only
  - GEO product contains both CERES and GEO fluxes and clouds
  - Terra Ed2 (Mar00-Oct05)
  - Aqua Ed2 (Jul02-Oct05) (New)

CERES spatially gridded and temporally averaged (level 3) products

- SRBAVG Ed2E Daily means (new)
  - Same as SRBAVG except for daily output
  - Terra Ed2 (process Mar00-Oct05, due Nov 2008)
  - Aqua Ed2 (process Jul02-Oct05, due Dec 2008)
- SYN/AVG/ZAVG (new)
  - Temporally averaged synoptic radiative transfer modeled profile fluxes consistent with CERES and GEO TOA fluxes, clouds and aerosols
  - GMT 3-hourly (SYN), monthly 3-hourly and monthly means (AVG), and zonal and global means (ZAVG)
  - Terra Ed2 (process Mar00-Oct05, due Dec 2008)
  - Aqua Ed2 (process Jul02-Oct05, due Feb 2009)
  - Terra Beta3 (Mar00-Sep04)
- Extend SRBAVG, ISCCP-like-GEO and SYN/AVG/ZAVG to Dec07
  - First to Dec06, late 2008 SRBAVG, mid 2009 SYN/AVG/ZAVG
  - Second to Dec07 ~ 1 year after SFC